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COMPUTATION OF LOGARITHMS.

By A. W. WILLIAMSON, Augustana College, Illinois.

A table of logarithms may be computed more expeditiously by using the original series than by the usual method.

$$\text{I.}\quad l\tfrac{5}{4}=-l\tfrac{4}{5}=\tfrac{1}{5}+\frac{1}{2.5^2}+\frac{1}{3.5^3}+\ldots.(1),$$

$$l\tfrac{6}{5}=l(1+\tfrac{1}{5})=\tfrac{1}{5}-\frac{1}{2.5^2}+\frac{1}{3.5^3}-\ldots.(2).$$

Sum (2) by taking twice the sum of its negative terms from $l\frac{5}{4}$. Find in like manner the logarithms of $\frac{9}{10}$, $\frac{11}{10}$, $\frac{49}{50}$, and $\frac{51}{50}$. Then $l\frac{3}{2}=l\frac{6}{5}-l\frac{4}{5}$, $l\frac{3}{5}=l\frac{9}{10}-l\frac{3}{2}$, $l2=l\frac{6}{5}-l\frac{3}{5}$, $l3=l(3\div2)+l2$, $l5=l(5\div3)+l3$, $l7=\frac{1}{2}l49$, $l11=l(11\div10)+l10$, $l13=l(1000+1)-l77$, $l17=l51-l3$, $l19=l(400-1)-l21$, $l23=l(300-1)-l13$, $l29=l(2000+1)-l69$.

II. The following sets of series converge more rapidly. Find the logarithms of $\frac{9}{10}$, $\frac{11}{10}$, $\frac{19}{20}$, $\frac{21}{20}$, $\frac{24}{25}$, $\frac{26}{25}$, $\frac{49}{50}$, and $\frac{51}{50}$ as above. Then $l\frac{441}{400}=2l\frac{21}{20}$, $l\frac{9}{8}=l\frac{441}{400}-l\frac{49}{50}$, $l\frac{5}{4}=l\frac{10}{9}+l\frac{9}{8}$, $l\frac{25}{16}=2l\frac{5}{4}$, $l\frac{3}{2}=l\frac{25}{16}+l\frac{24}{25}$, $l\frac{9}{4}=2l\frac{3}{2}$, $l2=l\frac{9}{4}-l\frac{9}{8}$, $l3=l\frac{3}{2}+l2$, $l5=l\frac{5}{4}+l4$, etc.

III. Divide 1 by 2, the quotient by 2, and so on; then divide the first term by 1, the second by 2, etc., placing the divisors in a second column and the quotients in a third. The sum of the third column is evidently the logarithm of 2. Subtracting twice the sum of the even terms of the third column from its sum gives the logarithm of 3. The logarithms of all other numbers up to 100 may be found by dividing terms of the first column including unity only by powers of 10 and the number of the term. In computing an entire table this method would prove more expeditious than either of the preceding.

$l5=l(2^4-1)-l3$, $l7=l(2^6-1)-l9$, $l11=l(100-1)-l9$, $l13$, $l19$, and $l29$ as above; $l17=l(2^8-1)-l15$, $l23=l(160+1)-l7$, $l31=l(2^{10}-1)-l33$, $l37=l(1000-1)-l27$, $l41=l(2^{10}+1)-l25$, $l43=l(4000-1)-l93$, $l47=l(800-1)-l17$, $l53=l(160-1)-l3$, $l59=l(100\times2^{15}+1)-l(3^2.11^2.17)$, $l61=l(1280+1)-l21$, $l67=l201-l3$, $l71=l(640-1)-l9$, $l73=l(2^9-1)-l7$, $l79=l(100\times2^6-1)-l81$, $l89=l(800+1)-l9$, $l97=l(100\times2^5+1)-l33$.